**Climate
of the Past**

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Discussions

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Interactive comment on "How wrong are climate field reconstruction techniques in reconstructing a climate with long-range memory?" *by* Tine Nilsen et al.

Anonymous Referee #3

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Nilsen et al. provide a new test of a critical assumption in CFR, namely how assumptions inherent to various reconstruction techniques may change our interpretation of climate variability on different time scales. They test two main hypotheses, investigating whether surface temperature data can be estimated via pseudoproxy experiments using a Gaussian function with prescribed scaling parameter, or via an AR(1) process with parameters estimated using BARCAST. The paper demonstrates that variability in climate reconstructions may reflect not only the true variability of the proxy data, but might also contain interference / confounding influences of model-fitting that may be incorrect.

C1

This is a very (refreshingly, thank you!) well-written paper and I enjoyed learning about their work. I have some suggestions for minor revisions that might strengthen the paper, but feel that given a bit more work it will prove an important contribution to Climate of the Past.

Namely, I tend to agree with one of the other reviewers that there is not enough direct comparison between the strength of the BARCAST methodology and the other CFR techniques so as to further test the fallout of the assumptions regarding AR1 vs. fGn data. While the authors do review the other techniques in detail which is informative, a direct comparison on the data they've generated in this manuscript using the other available tools would make this much stronger.

The authors also have not included any discussion of the GraphEM CFR technique despite it's inclusion in Wang et al., 2015 (which they cite) – should this CFR method not also be discussed in terms of relative performance? There are also a number of other citations that I believe should be added to the Discussion which I have listed below.

Finally, for the final paragraph of the Concluding Remarks, I was really left hoping for a more forward - looking statement about the future of this field and what your work contributes towards a broader knowledge of our estimates of past climate variability from proxies using these techniques. I think an effort could be made to solidify your findings and put them in a broader scope at the very end of the paper and put your work in context. How does your work enhance our ability as a field to interpret CFRs of past climate variability? What are the truly broad impacts or your work?

Overall, a very nice manuscript. As a general comment, as a person who is not a true expert in CFR, it would be nice if the authors could make an attempt to help readers who may not be as familiar with these topics with real-world examples or layman's terms where appropriate.

Line-by-Line comments: 1.2 comma splice after techniques, remove 2nd line of Intro-

duction, remove 'a' before 'considerable' 2.8 remove "among other things" and revise to "can occur, among other reasons, due to..." 2.19 hyphenate pseudo-instrumental 2.24 Start sentence with and revise 'Available pseudoproxy studies have to a large extent...' 3.1-10 really nice description here! 3.18 'nongaussianity' I think should be non-gaussianity w/hyphen 4.5-20 Why no mention of GraphEM methodology and comparison with like methods? Citation:

Guillot, D., Rajaratnam, B. and Emile-Geay, J., 2015. Statistical paleoclimate reconstructions via Markov random fields. The Annals of Applied Statistics, 9(1), pp.324-352.

4.25 awkward use of comprises – revise to 'Sect. 3 is comprised of an overview' 4.27 change discuss to discusses

Page 12.3 revise "F refers to ..." 12. 16 Figure 9 doesn't get much description or introduction but you partition it away for some reason. Can you please give more information about why you say, for example, 'except Fig. 9' – what is different about Figure 9 exactly? This comes up again on line 12.23.

Page 15 Lines 1-15 I think you need to beef up your discussion here about millennium-long paleoclimate reconstructions, because there are quite a few more citations whose work should be added to the discussion here, especially those which include model-data comparisons, including:

Ault, T.R., Cole, J.E., Overpeck, J.T., Pederson, G.T., Meko, D.M., 2014. Assessing the risk of persistent drought using climate model simulations and paleoclimate data. J. Climate 27 (20), 7529–7549.

Ault, T.R., Cole, J.E., Overpeck, J.T., Pederson, G.T., George, S.St., Otto-Bliesner, B., Woodhouse, C.A., Deser, C., 2013. The continuum of hydroclimate variabil- ity in western North America during the last millennium. J. Climate 26 (16), 5863–5878.

Dee, S.G., Parsons, L.A., Loope, G.R., Overpeck, J.T., Ault, T.R. and Emile-Geay, J.,

2017. Improved spectral comparisons of paleoclimate models and observations via proxy system modeling: Implications for multi-decadal variability. Earth and Planetary Science Letters, 476, pp.34-46.

Laepple, T., Huybers, P., 2014a. Global and regional variability in marine surface temperatures. Geophys. Res. Lett. 41 (7), 2528–2534. http://dx.doi.org/10.1002/2014GL059345.

Laepple, T., Huybers, P., 2014b. Ocean surface temperature variability: large model-data differences at decadal and longer periods. Proc. Natl. Acad. Sci. 111 (47), 16682–16687.

In Section 5.1, you go into the issues with TRW and your estimates of the PSD. The issues with TRW and de-trending methods, especially how this alters the power spectrum, is discussed in Section 3.2.5. of Dee et al., 2017 as listed above and you should compare your analysis to that paper as needed.